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since its type, *M. militaris*, is closely related to Gerstäcker's *schistacea*.¹ The species of *Myrma* may then be grouped under several subgenera, names for two of which are here suggested for the first time, as follows:

Genus MYRMA Billberg (1820) = *Polyrhachis* F. Smith (1858).

1. Subgenus: *Campomyrma* subgen. nov.
= Cohors *Polyrhachides camponotiformes* Emery.
Type: *Polyrhachis clypeata* Mayr.
2. Subgenus: *Myrma* Billberg = *Hoplomyrmus* Gerst.
= Cohors *Polyrhachides carinatae* Emery.
Type: *Formica militaris* Fabr.
3. Subgenus: *Polyrhachis* F. Smith.
= Cohors *Polyrhachides hamatae* Emery.
Type: *Formica bhamata* Drury.
4. Subgenus: *Hagiomyrma* subgen. nov.
= Cohors *Polyrhachides arciferæ* Emery.
Type: *Formica ammon* Fabr.
5. Subgenus: *Hemioptica* Roger.
Type: *Hemioptica scissa* Roger.

A third generic name, *Formicina* Shkd., which has been overlooked, is mentioned in the foregoing citation from the work of Swainson and Shuckard. This citation and the context seem to show that Shuckard accepted *Formica* Linn. in a restricted sense as the equivalent of what we now know as *Camponotus* Mayr., probably with the type *Formica herculeana* Linn., but this is open to doubt since no species is cited. On the same page two well-known ants are mentioned as species of *Formicina*, viz., *F. rufa* Linn. and *F. flava* Fabr. If only the former species had been mentioned, we might have been compelled to change our modern genus *Formica* to *Formicina*, but as Shuckard included also *F. flava* (which is at present *Lasius flavus*) in the same genus, we see that *Formicina* is merely a synonym of *Formica* as used by Fabricius and his contemporaries, possibly minus the group now known as *Camponotus*. Under the circumstances I can see no reason to replace any of the modern subdivisions of the old Linnean genus *Formica* with *Formicina* Shuckard.

W. M. WHEELER

¹ According to Emery *schistacea* is merely a subspecies of *militaris*.

ON MUSCOID AND ESPECIALLY TACHINID SYNONYMY

THE time seems ripe for a few remarks on this subject. There exists in the superfamily Muscoidea an immense taxonomic field awaiting exploitation, and it is to be hoped that it will attract many able workers imbued with a proper sense of responsibility, for it is at the same time a biologic field of first importance and magnitude as regards arthropod and general invertebrate evolution. Only one caution is necessary to those who would enter this field, as well as to those already in it—and this applies as well to all workers in whatever field—which is to do one's work so thoroughly as to secure absolute finality before drawing positive conclusions. In other words, do not make an unqualified statement before going to the bottom of the matter in hand. Results secured during the past three years have demonstrated conclusively that finality in the taxonomy, and consequently in the synonymy, can not be secured in this superfamily by the off-hand comparison, or even by the most careful study, of external adult characters alone.

Mr. D. W. Coquillett, in his "Revision of the Tachinidæ of America north of Mexico,"¹ without the knowledge just mentioned and thus without any true conception of the great difficulties before him, moreover without a good eye for external characters and with little appreciation of their importance, but nevertheless with the best of intentions, attempted to group these flies comprehensively and indicated extensive but often incorrect synonymy, lumping even distinct genera under one species in the most uncouth but seemingly plausible manner. We can not but admire the industry and ingenuity which have contributed to produce this work, while we deplore its great lack of quality. Dr. J. M. Aldrich, in his "Catalogue of the North American Diptera,"² also without the above knowledge but with a somewhat better eye for external characters, though following Mr. Coquillett quite faithfully in the main, has resurrected a few

¹ Techn. Ser. Bull. No. 7, Div. Ent., U. S. Dept. Agr., 1897.

² "Smiths. Misc. Colls.," No. 1444, 1905.

species from the latter's synonymy. My own publications on the subject, which have been quite extensive and in which I have proposed many new genera and species, no small part of which may quite possibly have to go in the final synonymy, were produced almost in whole without the above knowledge but with a very considerable appreciation of the necessity for a most careful and minute comparison of external characters. Brauer and von Bergenstamm's monumental work, performed under the same conditions, and unquestionably the best and most advanced of all, must be classed here too, along with all other taxonomic work in the Muscoidea to 1908. The results in all these cases have been quite unfortunate, considering the amount of time and energy expended. All the material handled by Mr. Coquillett will have to be restudied with great care in the light of dissections of fresh material from type localities. My own types and those of Brauer and von Bergenstamm will have to be restudied in the same manner. In fact, all accessible muscoid types the world over will have to be restudied in this new light. Here is an amount of work to be done that almost staggers one to contemplate.

Brauer and von Bergenstamm possessed a most acute appreciation of the necessity for searching out even the most minute external characters in order to arrive at the true relationships of the forms. They probably carried the study of the external adult characters about as far as it can be advantageously done without correlation with the reproductive and early-stage characters. I have perhaps gone somewhat farther in my consideration of the external adult characters in the "Taxonomy of the Muscoidean Flies,"* but so far as I yet know without any great improvement in the general results. It is thus evident that, for the future, the older order of taxonomic work in these groups must be exchanged for the newer one, which has come into full light but recently, and which demands the exhaustive study not only of the external and largely the internal characters of the adult, but also of the

characters of the eggs and early stages. It may even greatly profit by a study of general bionomics, especially host relations.

It is truly a most remarkable state of affairs that finds us at the present day unable to define some of the most common genera of tachinid flies. Nevertheless, such is the fact and necessarily follows from what has here been said. The type species of each genus must be dissected before we may know what species, themselves dissected, can be referred to that genus. The material for such dissections should be fresh, and that for type dissections should be obtained from the type localities so far as possible. I have already done this work for a considerable number of genera, and the results will, I hope, be published within the year accompanied by necessary drawings. But hundreds of genera, many of them represented by names long in common use, remain to be investigated in this manner, and thus we frequently find ourselves at this late day unable to determine material in these groups with any hope of finality.

In a recent letter to me, Dr. John B. Smith has restated the conditions in the following apt words, which I can not refrain from quoting:

It is perhaps not surprising that in the Diptera, which are without any doubt physiologically the most highly developed of all orders, the difficulties in classification should be greatest. Their specialization has extended in so many directions that the divergencies have become marked by internal modifications rather than external adaptations.

He precedes these remarks by stating his belief "that it will require a study of the internal organs to get a satisfactory classification, which may afterwards be helped out by external characters whose importance is not recognized at the present time." This remark is well worthy of consideration. The correlation of the external adult characters with those of the reproductive system and early stages will define the relative taxonomic value of the first in the various groups, and may reveal unsuspected characters among them which will hold good for considerable series of groups.

*"Smiths. Misc. Colls.," No. 1803, May, 1908.

The publication at this time of these remarks in their present form has been prompted by the recent appearance of Mr. W. R. Thompson's "Synonymical and other Notes on Diptera,"⁴ which have just reached me and which I am extremely glad in this case to see published, since they are here serving the useful purpose of calling forth some timely observations that would otherwise have been reserved for the future. It is hardly possible that the synonymy indicated in the above-mentioned notes will eventually prove to be final. If so it will indicate the possession on the part of its author of most astute perception and perfect judgment of external adult characters, such as I myself can not lay claim to after more than twenty years' study of these flies. For the present, it certainly can not be accepted as such. No matter how carefully done or how clear one's perception, final synonymy in these groups can not be attained by the mere comparison of external anatomical parts in museum material, types or otherwise. It will henceforth be simply a waste of time, energy, paper and ink to put forth such results without correlation with the other characters mentioned, and I will therefore not discuss here the merits of the points raised in these notes, of most of which I have very serious doubt. But I shall return to these points as soon as I can secure proper material for the necessary dissections.

If students wish to further the interests and advance the status of muscoid taxonomy, let them collect, rear and dissect long series of specimens from the type localities concerned; they will then be in a position to deduce final synonymical conclusions. Any other course in the present stage of progress of the work will only further obscure the subject. The same ground will all have to be covered again and all raised or unraised points thoroughly probed to the bottom. In the study of these flies, no matter who agrees as to synonymy, whether generic or specific, if they have not done their work exhaustively their agreement is of slight interest to the matter in hand.

⁴ *Psyche*, October, 1910.

The statement that I am going to make now will probably astonish some people, but I can truthfully say that I would be greatly pleased to see half the generic and specific names that have been proposed in the Muscoidea safely relegated to the synonymy where they could rest undisturbed and buried forever, with no hope of a resurrection, a goodly sprinkling of my own among the number; but such a considerable reduction of names is hardly possible of realization. Looking toward a consummation of final synonymy, however, I shall hope to accomplish in the next few years some portion of the work necessary to this end, during the course of which I here pledge my word that those generic and specific names of my own making will receive the same impartial treatment at my hands as all others. My one wish in this matter is to secure certainty before putting a name into the synonymy. The making of incorrect synonymy is a much more serious taxonomic offense than proposing further names for forms already named. In the latter case the forms can always be definitely referred to by means of the names that have been bestowed upon them, but in the former case serious confusion is certain to ensue.

The main interest here, as elsewhere in biology, centers in the relationships, phylogeny, bionomics and kindred aspects of the forms, and this knowledge must point the way to a sound taxonomy. In many groups of organisms this knowledge largely follows a fairly stable system of classification, but here it must precede it. It only remains to impress repeatedly upon the student the extreme difficulty at best of rightly interpreting the characters in such a multitude of forms, many of which are closely similar in the adult; the at least present impossibility in many cases of separating these forms on external adult characters alone; and therefore the absolute necessity for making an exhaustive study with reference to all taxonomically utilitarian characters, external and internal, of all stages.

Let no one think that I have over-estimated the needs of this subject in the foregoing remarks. I further wish to say, in conclusion,

that without doubt all biologists, myself included, will take great pleasure and satisfaction in welcoming to this field all careful workers, whose services should be much appreciated where there is such a vast amount of labor waiting to be performed.

CHARLES H. T. TOWNSEND

PIURA, PERÚ,
January 29, 1911

SPECIAL ARTICLES

METAMORPHOSIS WITHOUT PARASITISM IN THE UNIONIDÆ

It has been known for a long time that in the genus *Strophitus* Rafinesque the embryos and glochidia are embedded in short cylindrical cords which are composed of a semi-transparent gelatinous substance, and that these cords, which are closely packed together, like chalk crayons in a box, lie transversely in the water-tubes of the marsupium. The blunt ends of the cords are seen through the thin lamella of the outer gill, which in this genus, as in *Anodonta* and others, constitutes the marsupium. The position of the masses of embryos, while contained within the gill, is so unusual that Simpson in his "Synopsis of the Naiades" established a special group, the Diagenæ, for *Strophitus*—the only genus of the family in which this peculiarity exists. In other genera the embryos are conglutinated more or less closely to form flat plates or cylindrical masses, each one of which is contained in a separate water-tube and lies vertically in the marsupium.

So far as we are aware, Isaac Lea¹ was the first to observe this interesting arrangement which he described and figured, rather crudely to be sure, in *Strophitus undulatus* (*Anodonta undulata*). In several subsequent communications² he added further details and illustrations, and also mentioned the occurrence of the transversely placed cords, or "sacks" as he called them, in *S. edentulus*. He recorded the former species as being gravid from September until March, and described the extrusion

of the cords from the female, as well as the remarkable emergence of the glochidia from the interior of the cords after the latter have been discharged. "The sacks were discharged into the water by the parent," he says, "from day to day, for about a month in the middle of winter. Eight or ten young were generally in each sack, but some were so short as only to have room for one or two. . . . Immediately when the sacks came out from between the valves of the parent, most of the young were seen to be attached by the dorsal margin to the outer portion of the sack, as if it were a placenta."

The essential points in these observations have since been verified by other investigators. Sterki,³ following the suggestion of Lea, has called the cords, which differ strikingly from the conglutinated masses of *Unio* and other genera, "placentæ"—thus indicating that he considered them to have a nutritive function. He also described the extrusion of the glochidia, when placed in water, and their attachment to the cord "by a short byssus thread whose proximal end is attached to the soft parts of the young." He further states that the glochidia are enclosed in the placenta when the latter are first discharged, and that after their extrusion they remain attached for some time.

Ortmann,⁴ in a paper on the breeding seasons of the Unionidæ of Pennsylvania, says of *S. undulatus*, which he regards as identical with *edentulus*:

I found this species gravid in the months of July, August, September, October; also in May. The latest date is May 22, 1908 (one out of eleven individuals). Among numerous specimens collected on May 14 and May 27, 1908, no gravid females were present, and during the month of June such were never found, although a good number of specimens were collected. The earliest date again is July 11. This gives an "interim" from the end of May to about the middle of July.

In a later paper Ortmann⁵ states that the discharge of the cords, which he proposes to

¹ "Observations on the Genus *Unio*," Vol. II., 1838.

² *Ibid.*, Vols. VI., X., 1858, 1863.

³ *Nautilus*, Vol. XII., 1898.

⁴ *Ibid.*, Vol. XXII., 1909.

⁵ *Ibid.*, Vol. XXIII., 1910.